

WHAT IS CLAIMED:

1. An interventional device comprising:

an elongate body, having a distal end and a proximal end, and having at least one internal lumen within said body for supplying fluid, said fluid supplied being called a primary fluid;

a cap and a nubbin which together define a narrow gap between the nubbin and the cap for directing fluid out of said elongate body at high velocity and at an approximately acute angle with respect to said elongate body;

said nubbin having a nubbin wall located adjacent said gap;

said nubbin wall providing an asymmetrical wall surface exposed to the primary fluid as it emerges from said gap;

whereby a primary fluid exiting the gap attaches to the nubbin wall surface of the nubbin and entrains a secondary flow of fluid which moves in an approximately retrograde direction towards said proximal end.

2. The interventional device of claim 1 further including:

a delivery sheath having a lumen said lumen having a first diameter.

3. The interventional device of claim 2 wherein said nubbin has a second diameter less than said first diameter.

4. The interventional device of claim 3 wherein said gap has a third diameter less than said second diameter, such that said nubbin forms a wall adjacent said gap.

5. The interventional device of claim 2 wherein said sheath and said elongate body may be moved with respect to each other.

6. The interventional device of claim 2 wherein said sheath and said elongate body are fixed with respect to each other.

7. A method of removing particulate debris from an occlusion in a vessel using a catheter assembly comprising:

inserting and advancing a first delivery sheath to a location near the occlusion;

inserting and advancing an interventional device to a location near the occlusion said interventional device of type having;

a gap for introducing a primary fluid flow in said vessel;

a nubbin having a second diameter smaller than said first diameter;

injecting fluid out of said gap while moving said interventional device in said vessel with respect to said delivery catheter.

8. The method of claim 7 wherein said moving step begins near said occlusion and ends after the interventional device enters the delivery sheath.

9. The method of claim 7 wherein said fluid is injected at a first injection pressure above the blood pressure in the vessel and expands to a second exhaust pressure in said delivery catheter where said exhaust pressure is above said blood pressure.

10. An interventional device comprising:
an elongate body having a fluid supply lumen and having an
inflation lumen:
a slit located in said elongate body communicating with said fluid
5 supply lumen permitting fluid to emerge from said fluid supply lumen at
an angle with respect to said elongate body;
a nubbin located adjacent said slit; said nubbin providing a wall
surface near the slit such that fluid emerging from the slit adheres to the
wall of the nubbin and flows along the wall surface;
10 a balloon located distal of said slit in communication with said
inflation lumen.
11. An interventional device comprising:
an elongate body having a fluid supply lumen and having an
15 inflation lumen:
a slit located in said elongate body communicating with said fluid
supply lumen permitting fluid to emerge from said fluid supply lumen at
an angle with respect to said elongate body;
a nubbin located adjacent said slit; said nubbin providing a wall
20 surface near the slit such that fluid emerging from the slit adheres to the
wall of the nubbin and flows along the wall surface;
a balloon located proximal of said slit in communication with said
inflation lumen.
- 25 12. An interventional device comprising:
an elongate body having a fluid supply lumen and having an
inflation lumen:
a slit located in said elongate body communicating with said fluid
supply lumen permitting fluid to emerge from said fluid supply lumen at
30 an angle with respect to said elongate body;
a balloon located distal of said slit approximately adjacent said slit
and said balloon in communication with said inflation lumen;

whereby said balloon provides a wall surface near the slit such that fluid emerging from the slit adheres to the wall of the balloon and flows along the wall surface of the balloon.

5 13. The interventional device of claim 12 further comprising:
a second therapy balloon proximal of said first balloon.

14. The interventional device of claim 13 wherein said second therapy
balloon is an angioplasty balloon.

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15. The interventional device of claim 13 wherein said second therapy
balloon is a stent placement balloon.

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16. The interventional device of claim 11 wherein said balloon is a stent
placement balloon.

17. The interventional device of claim 11 wherein said balloon is an
angioplasty balloon.

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